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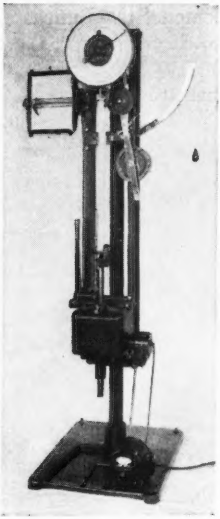
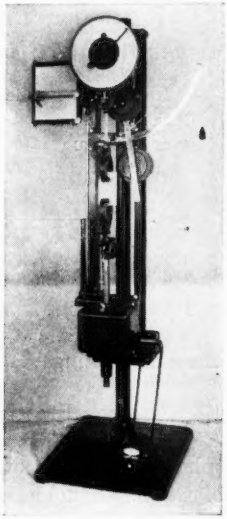


Yarn Tester



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TESTERS

Institute Proceedings

THE Board of Directors of the Institute held a regular quarterly meeting at the University Club, Boston, Mass., Thursday, Sept. 14, at which they made preliminary arrangements for the 10th annual meeting of members, authorized the start Oct. 1 of the research on the warp sizing of spun rayon and cotton-spun rayon, and the renewal as of the same date of the research on textile drying. Another action of especial interest to contributing members revives the allowance on each membership of the privilege of having any five of their accredited representatives receive TEXTILE RESEARCH during the membership year. Under the revised by-laws of 1938 contributing members were credited with only one subscription, the same as annual members, although paying dues of $50 as compared with $10 for the latter.

* * *

Tenth Annual Meeting

THE annual meeting and dinner of U. S. Institute for Textile Research, Inc., which is to be held at the Hotel Pennsylvania, New York, N. Y., Thursday, Nov. 2, will be its tenth, thus giving the organization a certain dignity of age, but while the Institute has a sufficient array of accomplishments to justify a celebration it has been thought wise to defer the latter until its tenth anniversary in November, 1940.

The Institute was formally organized at a meeting held in the Murray Hill Hotel, New York City, Nov. 6, 1930, and the late Dr. Samuel W. Stratton, then president of Massachusetts Institute of Technology, and formerly founder and director of the National Bureau of Standards, was its first president. Its by-laws provide that its annual meetings shall be held the first Thursday in November, and, irrespective of whether Thanksgiving is held on the 23d or 30th in New York City, the 2d will be the date of this meeting.

The tentative program provides for the annual meeting of members at 11 A.M.; a luncheon meeting of directors at 12:30 P.M.; a research conference, open to all who may be interested whether or not they are members, on the subject of "Wool Fibre Damage in Manufacturing," at 2 P.M.; and the annual dinner with a small number of outstanding speakers at 7 P.M.

The Open Conference

The subject for the open research conference is one that has been on the Research Council's list for some time as a possible subject for research. Submission of the subject to an open conference of interested members of the industry for explanation and discussion is the Institute's standard method for learning whether a subject, if subjected to scientific research, is likely to produce worthwhile results, and whether a representative cross-section of the industry wants such a study and is likely to support its financing.

This subject was proposed and endorsed by several manufacturers. It recognizes that over a decade or more a considerable amount of new basic knowledge regarding the physical and chemical properties of wool fibres has been discovered, and the question is raised as to what extent this knowledge has been adapted to the improvement of wool processing in both the worsted and carded woolen branches of the industry. A review of this new knowledge will be presented to the open conference by leading authorities, the discussion of its present and possible applications will then be opened by one or two speakers and open discussion will follow.

This session will be held under the direction of the Research Council, and will be more fully described in a bulletin to be issued later and obtainable from the Secretary.

Meeting Committees

The following committees will serve in connection with the annual meeting:

Committee on Meeting.—Ephraim Freedman, Chairman; A. M. Tenney, D. G. Woolf and C. H. Clark.

Committee on Nominations.—D. G. Woolf, Dr. A. C. Walker, Fessenden S. Blanchard.

Budget Committee.—Dr. E. H. Killheffer, Chairman; E. N. Hood and C. H. Clark.

* * *

A Textile Research Program

THE textile research and educational program of the Textile Foundation is to be presented at the morning session of the annual convention of the National Association of Cotton Manufacturers, to be held at the Copley Plaza Hotel, Boston, Wednesday, Oct. 18, by the same group of specialists who discussed these subjects at a series of meetings held at Southern textile schools last May. The session will be open to all who are interested in this work and opportunity will be given for discussion of the subjects to be presented.

The list of speakers as announced recently is as follows: Hiram S. Davis and George W. Taylor of the research department of the Wharton School of Finance and Commerce, University of Pennsylvania, under whose direction the study on "Vertical Integration in the Textile Industries" was conducted and was published last year, and who are now directing a study on "Inventory Policies and Statistical Guides," both of which studies were suggested by the Committee on Economic Research of U. S. Institute for Textile Research. Warren E. Emley, a member of the Foundation's advisory committee for scientific research, Chief, Organic and Fibrous Materials Division, National Bureau of Standards, Washington, D. C., and for many years chairman of the Institute's Research Council. Frederick M. Feiker, general secretary, American Engineering Council, and author of "Training Men for the Textile Industries," a Foundation publication. Stanley B. Hunt, member of the Institute's Committee on Economic Research and editor of *Rayon Organon*.

Electrophoretic Studies of Wool

By ARNOLD M. SOOKNE and MILTON HARRIS *

A Textile Foundation Publication

Abstract

A new investigation of the electrophoretic properties of wool shows that phthalate ion, used in buffers in earlier work, exhibits a specific ion effect, and shifts the isoelectric point to lower pH values. In acetate buffers, the isoelectric point of wool scales and cortical cells was found to be at pH 4.5. Samples of ground or powdered wool show an isoelectric point at pH 4.2. Much of the confusion which exists concerning the location of the isoelectric point has arisen from the assumption that the isoionic and isoelectric points are identical. The significance of both of these points in wool processing is discussed.

Introduction

The electrophoretic technique has been used for distinguishing protein surfaces,[1, 2, 3] and as a means of determining one of the characteristic constants of a protein, namely, the isoelectric point.

Considerable disagreement appears to exist concerning the pH at which wool is isoelectric, and the significance of the isoelectric point in wool processing. The chief difficulty arises from the fact that some of the values have been determined by methods which do not necessarily define isoelectric points. In the present paper an attempt is made to clarify this situation. In addition, the results of a new investigation of the electrophoretic properties of wool are presented.

As defined by Abramson[1] the isoelectric state of a surface is that electrical state in which the sum of the positive and negative charges at the surface over a time average is equal to zero. The *isoelectric point* then is defined as the reference concentration of hydrogen ion or some other ion (Th^{++++}, for example) at which this condition is found; *i.e.*, the condition at which the electrical mobility is zero. Although it has become customary to define the isoelectric point in terms of the pH scale, it must be defined in terms which include a complete description of the medium in which no migration takes place.

The *isoionic point* is defined as the point at which dissociable groups of the substance combine equally and only with hydrogen and hydroxyl ions.[6] This is identical with the isoelectric point only when the substance does not combine with ions other than hydrogen or hydroxyl. It follows

* Research Associates at the National Bureau of Standards, representing the Textile Foundation, Inc. This is the third publication of the new research program of the Textile Foundation at the National Bureau of Standards.

then that while it may be possible to determine the isoelectric point by several methods, as by titration, providing the substance combines with only hydrogen or hydroxyl ions, only an electrokinetic method can determine the isoelectric point in every case. The isoionic and isoelectric points of some soluble proteins have been found to be approximately the same. However, in the case of the insoluble materials, especially those which are more or less crystalline in nature, the isoelectric and isoionic points may be far apart. This is true of crystals of even relatively simple substances such as amino acids.[8] It has been suggested that in addition to the amphoteric properties at the surface, negative ions are also adsorbed at the surface resulting in a shift of the isoelectric point to lower pH values.

Values for the isoelectric point of wool obtained by a number of investigators are reviewed by Speakman and Stott,[4] and for that reason need not be given here. The important fact which should be emphasized is that with the exception of Harris' earlier value,[5] practically all of the values were based either directly or indirectly on determinations of the amount of hydrogen or hydroxyl ion bound by the fibre. The assumption was made that the isoelectric state of a substance is dependent only on the state of its dissociable acid and basic groups (its combination with hydrogen or hydroxyl ions), that the isoionic and isoelectric points are necessarily identical. This probably accounts for the discrepancy pointed out by Speakman and Stott[4] between the figures pH 5 and pH 3.4 for the "isoelectric" point of wool. The former was determined by titration, and may therefore be considered as the isoionic point.* The latter was determined by electrophoresis, and is therefore the isoelectric point in phthalate buffers. (See below for values in acetate buffers.) Speakman[9] explains the low value determined by electrophoresis as being caused by the presence of —NH— groups on the surface of the wool. While we agree that the low value is due to a surface phenomenon, it is hard to see how the kind of groups he postulates could cause a lowering rather than a raising of the pH value at which the wool is isoelectric.

Materials and Methods

Studies of the electrophoretic properties of wool are complicated by the fact that the fibres have a complex morphological structure. In the present investigation an attempt was made to study the component parts of the fibre. Measurements were made on cortical cells, scales, and what is assumed to be the intracellular substance. The scales were obtained by passing wool fibres through a Koerner grinder.[10] This machine produces very little cutting action since the blades are about $\frac{1}{16}$" apart. Microscopic examination of fibres so treated indicated considerable descaling, but the bulk of the fibres appeared to be uncut. Examination of the particles removed from the fibres showed them to be plate-like and about 2 microns in size.

Cortical cells were obtained by retting fibres with bacteria, and also from the dust in a carpet wear-testing machine † in which the fibres are broken down by mechanical action.

* In an investigation now in progress in this laboratory, it has been found that the point at which combination with acid begins is near pH 6.4.[7]

† The cells were obtained from a sample of undyed carpet which was subjected to a wear test on the Shawmut carpet testing machine. The disintegration of fibres under these conditions into cells has been reported by Schiefer and Cleveland.[11]

Fibres were also reduced to a convenient particle size by grinding in a laboratory Wiley mill or in a pebble mill. When the former was used, the wool was ground until it passed through a 60 mesh screen. The powder was suspended in water, the larger particles allowed to settle, and the particles (1 to 5 microns) remaining in the supernatant liquid were used for the measurements. Both methods of grinding destroyed the cell structure and presumably exposed the intracellular substance.

For the measurement of the electric mobility of ground wool particles, an Abramson horizontal microelectrophoresis cell was employed. The apparatus and methods were essentially the same as those described by Moyer.[12] The apparatus was checked from time to time by measuring the mobility of human erythrocytes in $M/15$ phosphate buffer at pH 7.4.[13] Either a 20x ocular and 20x objective or a 28x ocular and 40x water-immersion objective were used.

The mobilities of cortical cells of wool were measured in a vertical microelectrophoresis cell, similar to that described by Abramson, Moyer, and Voet,[14] since the rapid settling of these large particles made the use of the horizontal cell impossible. In the vertical cell, the particle settles in the plane of observation, and remains in the same electro-osmotic level throughout the measurement. The electric mobility of the particle is the mean of its velocities over a given distance in both directions. The effect of gravitational fall is thus eliminated. When the electric mobility is large compared to the velocity of gravitational fall, the distance travelled in one direction, divided by the mean of the times of transit with the current in both directions gives substantially the same result. In extreme cases (*e.g.*, in the immediate neighborhood of the isoelectric point) the electric mobility is very small compared to the gravitational fall, and reversal of the current may even fail to reverse the direction of motion of the particle.

Measurements were made in a constant temperature room at 25° C. to avoid convection currents caused by temperature differences. With solutions of ionic strength as low as 0.02 *M*, convection currents were caused by leaving the current on for even relatively short periods when the vertical cell was used. For this reason, all measurements in the vertical cell were made in solutions of 0.005 *M* ionic strength, and the current was left on for as short a time as possible. The 20x ocular and 20x objective were used for all measurements in the vertical cell. The cell was checked against the horizontal cell by measuring identical suspensions of wool in both cells. In general the vertical cell was found more difficult to use, and required more time for a measurement than the horizontal cell, which is well adapted to measurement of the mobilities of small particles.

pH values of the suspensions were measured with a MacInnes and Belcher type glass electrode and a vacuum-tube potentiometer, using a cathode-ray tube as null indicator. The pH values were referred to potassium acid phthalate 0.05 *M*, which was assigned a pH value of 4.01.[15]

Experiments and Discussion

Effect of buffers on the electrophoretic properties of wool. In a recent investigation relating to the electrophoretic properties of silk,[16] large ions of complex structure, such as phthalate or picrate, appeared to have specific effects which produced appreciable shifts in the pH-mobility curves.

retting.[18] If it is assumed that all such material would be removed during the long retting process, but that the cells obtained by mechanical action would still contain some of it, then the only conclusion which may be drawn from the present investigation is that if such a phase exists, it necessarily has the same electrophoretic properties as the outer surface of the cortical cells. Alternative conclusions that the intercellular phase is not completely removed during these treatments or that one does not exist are obviously not eliminated by these results.

Electrophoretic properties of ground and powdered wool. Fig. 3 shows the pH-mobility curve for samples ground in a laboratory Wiley mill (open circles) and in a ball mill (closed circles). The dotted curve is the curve taken from Fig. 2. It has been shown elsewhere,[19] and in this laboratory that the action of the ball mill results in a lowering of

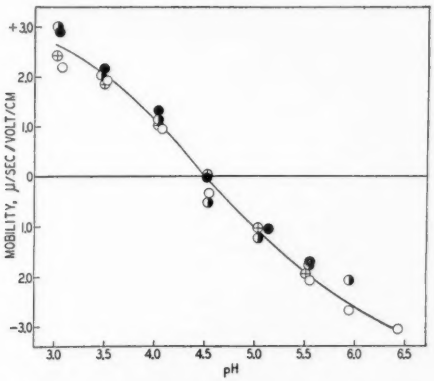

FIG. 2. A comparison of the pH-mobility curves of wool scales and three different samples of cortical cells in acetic acid—sodium acetate solutions of 0.005 *M* ionic strength. Scales prepared by grinding wool in Koerner machine, ⊕; cortical cells obtained by retting wool with bacteria for 4 months, ◑, and for 14 months, ●; and cortical cells prepared by grinding wool in a carpet-testing machine, ○.

the cystine content of wool, which suggests that the shift in the curve to lower pH values may have resulted from such degradation. It would appear, however, that the action of the Wiley mill is much less drastic, since no measurable degradation was exhibited by the ground fibres as a whole. However, since only the smaller particles obtained from the Wiley mill were used in these measurements, the possibility that they may be more degraded than the larger particles still exists.

Against the possibility that the shift may have resulted from such degradation, it must be pointed out that the action of both the Wiley mill and ball mill is such that the cortical cells are ruptured or cut and the intracellular substance exposed. This substance may have different electrophoretic properties than the remainder of the fibre. If this were the case, its isoelectric point would be expected to be even lower than that

Since phthalate buffers were used in the earlier work by Harris on the isoelectric point of wool, a reinvestigation of the electrophoretic properties of wool fibres was undertaken. The results shown in Fig. 1 were obtained on wool fibres ground in the laboratory Wiley mill. Curve 3 is the pH-mobility curve for wool in phthalate buffers and shows an isoelectric point at pH 3.4, in agreement with the earlier value of Harris'. Curve 1 is a pH-mobility curve for the same sample in acetic acid—sodium acetate buffers of 0.005 *M*, ionic strength. Under these conditions the sample is isoelectric at pH 4.2, a shift of approximately 0.8 pH unit. This shift is of the same order of magnitude as that obtained for silk. Curve 2 shows the results for the same sample in acetic acid—sodium acetate buffers of 0.1 *M* ionic strength, and shows that the shift in isoelectric point caused

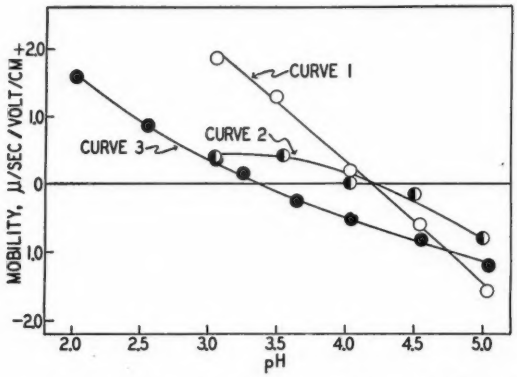

FIG. 1. The electrophoretic mobility in different buffer solutions of wool ground in a Wiley mill. Curve 1, 0.005 *M* ionic strength acetic acid —sodium acetate solutions. Curve 2, 0.1 *M* ionic strength acetic acid—sodium acetate solutions. Curve 3, Clark's phthalate buffers.

by the use of phthalate buffers is not the result of increased ionic strength, but has resulted from a specific ion effect.

Electrophoretic properties of cortical cells and scales. Fig. 2 shows the mobility as a function of pH in 0.005 *M* acetic acid—sodium acetate buffers for three different samples of cortical cells and one sample of scales. One sample of the cells was prepared by the mechanical action of the carpet tester on wool. The other samples were prepared by retting of the fibres with bacteria for periods of 4 and 14 months. The scales were obtained by subjecting wool fibres to the action of a Koerner grinder as previously described.

The results as shown by the curves indicate that all three samples of cortical cells and the sample of scales have the same electrophoretic properties and are isoelectric at pH 4.5 in the buffer system used. It has been suggested by many investigators that an intercellular phase exists between the cortical cells and is removed during prolonged treatment of fibres with certain reagents such as concentrated ammonia,[17] or during

processes involving either the removal or deposition of materials on the surface of the fibre. In other words, it would play an important part in such processes as scouring and finishing. Scouring is facilitated when the charge on a fibre and the charge on the material being removed from the fibre are the same and therefore tend to repel each other. For example, dirt particles and properties of most inert substances carry negative charges. Obviously then such macroscopic particles are best removed from fibres which also have a large net negative charge. Similarly, the deposition of certain finishing materials on fibres or fabrics is best accomplished when the charges on the fibres and material to be deposited are of opposite sign. While the dyeing problem is undoubtedly more complicated, it is probable that dyeing with colloidal dyes is related to the isoelectric point.

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shown in Fig. 3, since the solid curve is probably a composite of the curves for scales, cells, and intracellular substance. Further work is necessary to determine which of these postulates is correct.

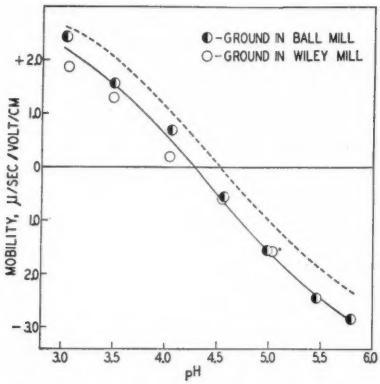

FIG. 3. A comparison of the pH-mobility curves in 0.005 *M* ionic strength acetic acid—sodium acetate buffers of wool ground in ball mill and Wiley mill. The broken line, identical with the smooth curve of Fig. 2, in included for comparison.

Significance of the Isoelectric and Isoionic Points

It has generally been assumed that the isoelectric point of wool represents the point of maximum stability of the fibre. Although isoelectric points of some proteins appear to be close to the points of maximum stability, they are not necessarily the same. Actually, it is possible for the stability region of a protein to be far from the isoelectric point.[10] Whether the point of maximum stability will be at or near the isoelectric point will depend upon the reactivity of specific linkages in the molecules. For example, assume that a protein containing disulfide linkages from the amino acid cystine has an isoelectric point in the alkaline region as a consequence of a high content of either lysine or arginine. In view of the known instability of disulfides in even weakly alkaline solutions, it is very unlikely that the point of maximum stability of such a substance would be located near its isoelectric point.

The concept of the isoelectric and isoionic points, however, can be utilized in practical wool processing. Since the isoionic point involves only the acidic and basic properties of the fibre, it should be considered in studying such wool processes as are related to these properties. Dyeing with soluble dyes,[21] felting, and removal of ash constituents from the fibre are processes that probably fall within this category. In addition, the swelling and tensile properties of wet fibres are a function of the state of their acidic and basic groups.[4, 22]

The isoelectric point, on the other hand, is concerned principally with the total net surface charge, and must only be considered in relation to

The Surface Friction of Yarns

Apparatus for Determination of the Coefficient of Friction

By DR. ERWIN J. SAXL *

Summary

Yarn friction is of considerable importance in the manufacture and conversion of all types of yarns and threads. It is indicative of the value of softening and lubricating compounds, of dyestuffs and chemicals, and also of the influence of sizing upon the yarn. Furthermore it indicates the effect of flyers, tension devices, and other guiding parts of machinery in roughening up the yarn.

In order to determine the coefficient of friction of yarns and thus to get knowledge of the running quality of threads, an apparatus has been developed whereby a yarn is lifted under precision conditions until a standard rider placed upon the yarn begins to travel. At this point the angle of inclination is read on a protractor and from this the coefficient of friction of the yarn is determined simply and quantitatively.

Introduction

IN the manufacture and processing of textile yarns and threads, from the spinning to the final weaving or knitting, it is the friction between the surface of the yarn and the contact points of the various tension devices, such as eyelets, sinkers, heddles and other guiding parts of operating textile machinery, that determines to a large extent the running quality of yarns or other filamentous materials. If the yarn is rough, hairy and has a harsh surface, the yarn tension will be high because of the resulting high frictional force; vice versa, a smooth yarn that is well oiled has a low coefficient of friction. Furthermore, a yarn that has low yield point stretches more under the influence of friction devices, thus setting up an apparently higher surface friction than a yarn the yield point of which is high.

Accordingly, determinations of the surface friction of yarns become of the highest importance, as they not only make possible the prediction of the running qualities of yarns as far as tension control is concerned under actual production methods, but in addition make it possible to determine quantitatively the influence that various textile auxiliaries and dyestuffs have upon the surface properties of yarns.

By binding the hairs towards the core of the yarn, one action of sizing compounds is to permit the yarn to glide more easily through the heddles

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and reeds. On the other hand, this cohesive film of starch, gelatin, or other sizing compounds put upon the yarn by the slashing procedure, may tend to make the sized yarn adhere to guides, etc., more than the yarn proper. Because of this, a knowledge of the surface friction makes it possible to find the optimum conditions in the slashing of spun yarns—the one point at which the best combination is achieved to reduce hairiness and counteract stretch without increasing the adhesive properties of the yarn to any marked extent.

Influence of Preparatory Operations

In adding lubricating compounds to a yarn (for instance, for throwing rayon by soaking with such mixtures as palm oils, mineral oils, sulfonated oils and emulsifying chemicals under given pH conditions) there are optimum relations with which a minimum expenditure of auxiliary chemicals produces a maximum and lasting lubricating film upon the yarn. An actual knowledge of the lubricating efficiency of various oils obviously has advantages; also the fact that when oiled yarns are stored their friction changes, and this is different for various oils.

Last, but not least, it is of paramount importance for the converter, spinner, weaver, throwster and knitter of yarns and threads to know quantitatively the influence that his various operations have upon the surface condition of the yarn, and also upon its action in the eyelet of a needle or the shed of a loom. Such action should be determined *before* the expense of inserting yarn into converting machinery is incurred. In this connection, it is most interesting to study quantitatively the influence that different percentages of relative humidity have with reference to the surface friction of yarns. Sometimes it is not the oiling and yarn lubricating compounds as such, but their combination with the proper atmospheric running conditions that influence the running qualities of a yarn.

Particularly in the making of thread, it is not only the waxing, oiling and singeing of the thread, but also the mechanical methods of its processing that influence its final smoothness. A yarn tension that is not new and smooth enough might roughen up an otherwise excellent yarn. Also, in spinning and throwing, improper flyers show their influence in terms of increased surface friction of the yarn, which may be discovered during operation by using a tension meter on the running yarn.

In the dyeing and finishing of the yarns, particularly in rope dyeing, it is the friction between the wet yarn and its supporting and immersing equipment that must be low enough so that the yarn is not damaged by stretching it beyond its yield point in the dye liquor. In this sensitive state of its processing, where the micelles move and the yarn swells, it is most important that the friction set up in the various parts be known so that they may be kept below the danger line.

Regardless of what textile operation it is, from the adjustment of yarn guides and spinning pumps in the manufacture of raw rayon or other synthetic yarns to spinning, throwing, slashing, soaking, weaving, braiding, knitting or any other intermediary step of yarn processing, the yarn will always be running over surfaces and through guides. By the interaction of these surfaces with the surface friction of the yarn, a tension is set up within the yarn which is counteracted by the cohesive properties within the yarn proper. Under equilibrium conditions, where the tension is lower than the cohesion in the yarn, the yarn runs without break. If the tension

is higher than the forces that hold the yarn together, a break occurs, resulting in loss of time while the machine is not operating, labor for tying up the break, and a knot in the goods. For all these reasons, to which may be added the necessity for keeping the expense of textile auxiliaries to a minimum, a quantitative knowledge of the surface friction of the yarn and the conditions by which it is affected is of great importance.

The Yarn Friction Tester

Various methods exist for the determination of yarn friction. They are influenced by the specific conditions under which a yarn is running. Generally, however, they are of two major classes: one is the coefficient of friction between yarn and comparatively larger surfaces such as rollers, beams, etc. Methods for this evaluation have been published previously.[1] The other relates to the interaction between the yarn and an eyelet. Whether it is a needle, a sinker or a heddle, the general shape of that part of the eyelet which touches the yarn is of major importance. In designing an instrument for the testing of the surface friction of yarns, both treated and untreated, the author gave the most careful attention to the designing of the eyelet or rider.

In order to approach uniform conditions, a standard eyelet was made as follows: A stainless steel rider of $\frac{1}{8}$ in. thickness was drilled with a drill of 0.160 in. diameter and thereafter reamed to exact size. This is, therefore, the diameter of the middle section. Thereafter, the hole was countersunk, the tip of the drill having 45° over its total head. The hole was countersunk from both sides with this drill in such a manner that the inner length of the hollow cylinder remaining was $\frac{1}{16}$ in. The position of the hole in the metal plate is shown in Fig. 1, in which can be noted the shape of the

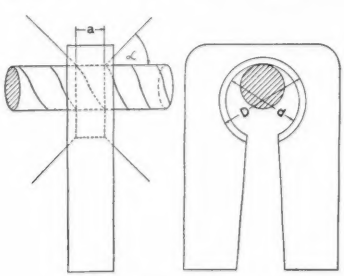

FIG. 1.

slot for the insertion of the yarn. This position is of importance, because it influences the center of gravity of the eyelet. After the countersinking the hole was reamed again to eliminate any shavings that possibly could have marred the edge.

This rider is hung upon a yarn which is held under standard conditions as follows: A few layers of yarn are first pulled off the bobbin to get a clean sample. As can be seen from Fig. 2, the yarn is inserted first into

[1] Erwin J. Saxl. "The Coefficient of Friction for Yarns." *J. Franklin Inst.*, June 1936, P. 789–95.

the auxiliary weighted clamp at the extreme left of the picture. The yarn is hereby held close to the clamp when it is inserted with the fingers. The yarn is then inserted in the clamp at the outmost right, pulling from behind the clamp so that the part of the yarn whose surface friction is to be investigated is entirely free from human touch. The weight pulling on the yarn can be adjusted to be of the same order as the tension applied to the yarn during manufacture.

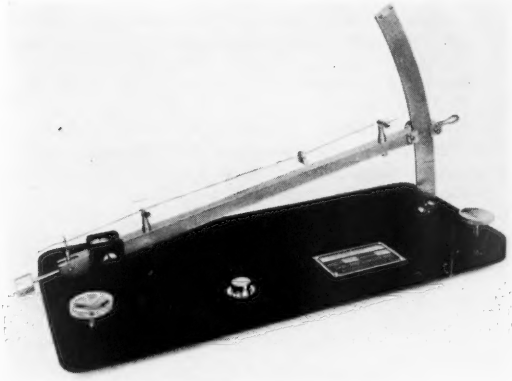

FIG. 2. Yarn Friction Tester.

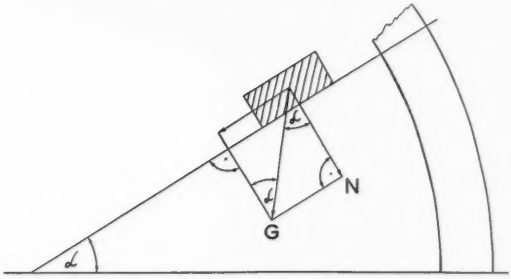

FIG. 3.

The operator now pulls with the right hand on the yarn behind the clamp at the extreme right, while with the left hand that clamp is gently opened. When the tilting weight at the extreme left is horizontal and aligned with the rest of the arm, the clamp at the extreme right is released. By these means, all yarns are inserted under one and the same tension; this is one of the important minor details, as the tension applied longitudinally upon the yarn changes its surface friction. After the yarn is pulled in this manner it is inserted into the clamp at the left and is now held between

the two main clamps. The rider is now placed upon the yarn close to the right clamp, by setting it with the slot upon the thread and releasing it gently. The instrument is now ready for the test.

The two clamps are mounted upon a tilting arm. The angle of the latter with the horizontal plane, which is adjusted with the aid of leveling screws and a spirit level, can be read to better than ¼ of 1° upon a large protractor, a sector of which is mounted at the right side of the base plate. There is a clamp attached to the tilting arm which may be fastened to the protractor from the back so that the rod may be fixed at any given angle. A micrometer adjusting screw permits the precise and slow lifting and lowering of the tilting arm. An electric vibrator may be mounted upon the instrument in order to eliminate starting friction.

With the aid of the handle and micrometer screw at the extreme right, and after the fastening screw is released, the arm is gently lifted at a uniform rate until the point is reached where the rider is smoothly and gently moving to the first third of the distance between the clamps, which point is marked on the supporting arm. At this point the screw in back of the protractor is fastened and the angle with the horizontal is read upon the protractor.

If the yarn is rough, hairy or covered with a tacky layer, the angle at which the rider moves freely is high. On the other hand, a smooth, well-oiled yarn permits the rider to move at a smaller angle. In this manner, the angles and fractions thereof which can be read upon the protractor permit a *direct comparison of the relative surface friction of different yarns. The smaller the angle, the smoother the yarn.* Furthermore, the smoothness is distributed evenly if the rider travels steadily, while a jerky motion from point to point is indicative of uneven distribution of hairs, oil, etc.

In comparing yarns against each other, it is advisable to use yarns of reasonably equal count or denier. A yarn of larger diameter will touch the eyelet along a greater distance than a yarn of smaller diameter. Accordingly, if identical areas of the rider are to be brought in contact with the yarn, the average yarn diameters should be identical.

In order to widen the range, and even to include narrow fabrics, it would be possible to specify a series of riders of different weights and with eyelets of different diameters. For most practical purposes, however, the above-mentioned dimensions of the rider have been found entirely sufficient for the investigation of the customary yarn and thread numbers, provided yarns of identical size are compared with each other. The influence of yarn diameter is eliminated in this manner and the only differences are factors such as the coating of the yarn, whether it has been roughened by pulling it over certain guides during the process of manufacture, and whether one oil is better than another.

Some auxiliaries adhere in spots. Spotting is another analysis that can be made with the use of this friction tester. The rider moves jerkily upon yarns of variable coefficient of friction along their length.

While it is entirely sufficient for the practical man to compare the various effects of different treatments and materials merely by comparing the numbers on the protractor where all that has to be considered is the fact that, everything being equal, the smaller the number on the protractor the easier the yarn glides through the eyelet, it is also possible to use this friction tester for determining the coefficient of friction of yarns, threads, wires and other filamentous materials in the absolute system.

Calculation of Coefficient of Friction

Let α be the angle at which the rider moves steadily, then it may be stated that at this point the following forces are compensated:

The kinetic friction (relative motion between yarn and rider) between the rider and the yarn upon which it rests, is according to a well-known law of physics the force necessary to bring about motion of the rider in contact with the yarn.

At the horizontal position of the yarn, N would be the normal pressure of the rider upon the yarn.

Lifting the yarn the angle α, the friction of the rider against the yarn will then be overcome when the component of motion equals the frictional component of the rider. Let G be the gravitational attraction, then it is simple to split this up into the component of motion W.

$$W = G \sin \alpha \tag{1}$$

The normal pressure, N, of the rider against the yarn, on the other hand, becomes

$$N = Gf \cos \alpha \tag{2}$$

whereby f is the coefficient of friction.

Inasmuch as at the critical angle the component of motion equals the frictional resistance R, we can then state that

$$R = W = G \sin \alpha \tag{3}$$

As this in turn equals equation (2) we then can say

$$Gf \cos \alpha = G \sin \alpha \tag{4}$$

and, therefore,

$$f = \frac{\sin \alpha}{\cos \alpha} = \tan \alpha \tag{5}$$

The latter formula makes it possible to determine the coefficient of friction of yarn versus metal (or any other material of which the rider may be built, such as plastics) under conditions of great precision. In order to facilitate comparisons in the absolute system, the protractor may be divided directly in the tangent function of the angle instead of the angle as such. In view of the fact, however, that most yarns permit the rider to slide at small angles, it is sufficient for most instances to assume that the angle as such is identical with its tangent function and to state the results found in angles directly. The above direct readings (in degrees) are sufficient in many instances for comparisons of one yarn with another.

Percentage of Lubricating Efficiency

From a viewpoint of quantitatively determining the differences in lubricating efficiency of various compounds, it is, however, more advisable to use the absolute system. Only in this manner can the percentages be determined so as to show which yarn is smoother or which oil more effective and by how much. Such percentage figures in turn permit the calculation

of whether it is more economical to use one oil of a lower price, a greater quantity of which is needed than of a higher priced oil.

Types of Friction

In moving yarns there are basically two forces to be overcome: one is the resistance that the yarn exerts against being drawn from a bobbin and through yarn guides, due to the *surface friction*. The other is the pliability of the yarn, which may be termed *internal friction* (stiffness). These two physical influences, which to a large extent control the running qualities of a yarn or thread and the power consumption of a mill, are distinctly different and should be strictly separated and broken down into their individual components before a prediction of the running qualities of a yarn can be attempted. The relative stiffness and softness of the yarns may be determined quantitatively with a Stiffness Tester [2] that completely eliminates the influence of surface friction.

In the following table the results of the averages of six determinations, each for different threads, are tabulated. It should be mentioned in this connection that the variations within the six determinations for each yarn are low, centering around an average symmetrically and having a total spread of not more than ½ to ¾ of 1°. This low spread of distribution and small variability indicate the reproducibility of results under test conditions.

Type of Yarn	Yarn Number	Angle	Tangent of Angle = f = Coefficient of Friction
Glazed Thread	36/4	6°	0.1051
Soft Finish	36/4	7½°	0.1317
Nylon with oil	230 denier	7½°	0.1317
Cotton with oil	35/3	7½°	0.1317
Nylon, no oil	230 denier	8°	0.1405
Merc. cotton, no oil	36/3	8½°	0.1495
Silk thread, waxed	640 denier	8¾°	0.1548
Cotton braid	22/2	15°	0.2679

As can be seen from this table the lowest surface friction is that of a heavily treated glazed thread. It should again be mentioned in this connection that the running qualities of a yarn are a compromise between a low surface friction and a low pliability of the yarn. This yarn, while having a friction angle of only 6°, is at the same time the stiffest of the lot and therefore is less satisfactory from a running viewpoint. With the aid of the Stiffness Tester and the Friction Tester, however, the influence of these two separate components upon the running qualities of the yarn can be broken down separately, and the proper steps may then be taken in the choice of materials and modification of preparatory procedure which produces the optimum condition between the lowest stiffness and lowest surface friction of the yarn for a given tensile strength.

[2] Erwin J. Saxl. "The Determination of Stiffness and Resiliency in Individual Yarns." *Text. Rsch., VI,* 3, 152 (1936). "The Quantitative Measurement of Stiffness and Resiliency." Paper read at the annual meeting, A. A. T. C. C., Philadelphia, Pa., Dec. 4, 1937; published in *Rayon Tex. Mo.,* Jan. 1938.

Abstracts

Committee on Abstracts and Bibliography:
E. R. Schwarz, Chm., Dr. E. J. Saxl, C. H. Clark.

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I. Fibres (Synthetic and Natural) and Fibre Analysis

Cellulose: Formation of—in the Cell Wall. K. Hess, H. Kiessig, W. Wergin and W. Engel. *Ber.*, 1939, V. 72, P. 642–52; abs. in *J. Soc. Dyers Col.*, June 1939, P. 325.

Comparison of the X-ray diagrams with the results of optical polarization investigations of cellulose indicates that the appearance of the X-ray diagrams is parallel to the occurrence of strong double refraction. This observation supports the existence of a lattice structure in cellulose. The X-ray diagrams and double refractivity are apparent in the primary wall after removing a component by extraction with water, and it can be assumed, therefore, that both these observations are intimately connected with the removal of this substance. This latter is not a fatty-wax phase, as formerly supposed, but an amorphous substance, X, or mixture of substances, containing phosphorus and nitrogen. Although it is difficult to determine the extent to which this substance is distributed in the wall and in the hair, quantitative experiments have indicated that at least a portion occurs in the cell wall and is arranged in such a way as to interfere with the lattice arrangement of the cellulose. The observation that the substance X can only be removed by extraction with water after first removing the wax phase, indicates that the complex of cellulose and substance X is embedded in the young walls of the wax. Two possible mechanisms are suggested to account for the formation of cellulose *in vivo*. According to one theory, substance X actually assists in the formation of the cellulose and, when its formation

is complete, it must be removed so that the cellulose can assume a lattice structure. On the other hand, if substance X functions only by retarding crystallization of the cellulose, then it must always be present in the primary wall, but, when formation of the secondary wall commences, production of substance X ceases, or becomes so weak that a number of cellulose molecules coalesce to form crystallites and so produce a lattice structure. (C)

CELLULOSE HYDRATE FILAMENTS: STRUCTURE. P. H. Hermans, O. Kratky and P. P. Platzek. *Kolloid-Z.*, 1939, V. 86, P. 245–53; abs. in *J. T. I.*, June 1939, P. A406. (C)

CELLULOSE THREADS AND FILMS: COMPOSITION OF. O. Kratky and H. Mark. *Ind. Fibres Rev.*, 1939, V. 3, P. 158; abs. in *J. T. I.*, June 1939, P. A410.

A general account is given of problems regarding the structure of the individual cellulose molecule, and an outline is given of the micellar system in which the crystallized areas (micelles) are assumed to be interspersed with amorphous areas to form a kind of network. Methods involving the use of X-rays for the determination of the absolute dimensions of the micelles are discussed, and an account is given of the study of the structure of micelles by producing deformation and following by means of X-rays, etc., the processes that ensue. (C)

DECOMPOSITION OF CYSTINE IN AQUEOUS SOLUTION. J. I. Routh. *J. Biol. Chem.*, Nov. 1938, P. 147–54; abs. in *Eastman Kodak Abs. Bull.*, March 1939, P. 178.

Cystine was boiled with distilled water in both air and nitrogen and the rate of decomposition was about the same for both. There was a progressive decrease in pH during heating which must have been due to acid decomposition products, since the nitrogen content remained constant and no ammonia was liberated. (S)

FIBRES: MICELLAR ORIENTATION AND STRETCH. S. Oka. *Kolloid-Z.*, 1939, V. 86, P. 242–5; abs. in *J. T. I.*, June 1939, P. A406. (C)

JUTE AS SEEN BY MODERN RESEARCH. F. G. Brown. *Text. Col.*, Feb. 1939, P. 83–5. (C)

JUTE FIBRES: COMPARATIVE OBSERVATIONS ON SWELLING OF. W. G. Macmillan and M. K. Sen. *T. I.*, April 1939, P. T73–82.

Data are recorded for the changes in diameter of jute fibres in water, acids, alkali, and certain commonly used emulsifying agents. The effects of whale oil, groundnut oil and mineral oil have also been examined. Swelling in alkali is greater, and in acid less, than that in distilled water. At 100% concentration the swelling effect of all the emulsifiers is small, whereas in aqueous solutions it is considerable. The oils examined were characterized by their non-swelling property. (C)

LANITAL FIBRE: CHEMICAL AND PHYSICAL CHARACTERISTICS. A. Barbera, A. Algerino and G. Buzio. *Boll. Assoc. Ital. Chim. Tessile Coloristica*, 1939, V. 15, P. 2–16; abs. in *J. T. I.*, June 1939, P. A408. (C)

MOISTURE RELATIONSHIPS OF JUTE. S. G. Barker. *Indian Jute Mills Assoc., Res. Dept.*, Feb. 1939, 153 pp.; abs. in *J. T. I.*, April 1939, P. A240.

A comprehensive survey of measurements and data relating to the regain of jute, including descriptions of the majority of methods of measuring regain of textiles. The role of moisture in the attack of micro-organisms upon jute, and the sampling of jute for the commercial evaluation of regain are also discussed. (C)

MOLECULAR WEIGHTS OF CELLULOSES AND CELLULOSE DERIVATIVES. E. O. Kraemer. *Ind. Eng. Chem.*, Oct. 1938, V. 30, P. 1200–03; abs. in *Eastman Kodak Abs. Bull.*, March 1939, P. 179.

An examination was made of the intrinsic viscosities and molecular weights as determined with the slow-speed Svedberg ultracentrifuge. It is concluded that in dilute solutions in suitable solvents the cellulose materials are dispersed to single molecules and that the ultracentrifuge measures true molecular weights. (S)

"PE CE" POLYVINYL CHLORIDE FIBRE: PROPERTIES. H. Jentgen. *Kunstseide*, 1939, V. 21, P. 124–5; abs. in *J. T. I.*, June 1939, P. A409. (C)

PROTEINS: STRUCTURE OF. J. D. Bernal. *J. Soc. Dyers Col.*, June 1939, P. 308–10.

A summary of present knowledge of protein structures. The author concludes as follows: The problem of protein structure is now a definite and not unattainable goal; most of the work done at present is unco-ordinated; different workers examine different proteins by different techniques, whereas a concentrated and planned attack would probably save much effort and lead to an immediate clarifying of the problem. (C)

TEXTILE FIBRE: PRODUCTION OF—BY U. S. CASEIN PATENT. Whittier and Gould. *Rayon Text. Mo.*, Jan. 1939, P. 62. (C)

TIOLAN FIBRE: PROPERTIES. R. Hünlich. *Zellwolle*, 1939, V. 5, P. 94–6; abs. in *J. T. I.*, June 1939, P. A409.

The production of the German casein fibre, Tiolan, is briefly discussed and its properties are described and compared with those of wool, and other fibres. (C)

WOOL-LIKE STAPLE FIBRES: DEVELOPMENT. *Klepzig's Textil-Z.*, 1939, V. 42, P. 1–10; abs. in *J. T. I.*, April 1939, P. A256.

The development of staple fibre suitable for use in the wool industry (W-staple fibre) and the properties required in such fibres are discussed. It is pointed out that staple fibres equivalent to wool in handle, elasticity, felting power, crease resistance and wearing qualities have not yet been produced. Hydrophobic, crease-resistant and animalized fibres are mentioned. (C)

WOOL AND RELATED FIBRES: ACTION OF LIGHT ON. J. B. Speakman and P. R. McMahon. *N. Z. J. Science & Tech.*, Mar. 1939, P. 248–64B.

This paper is the first of a series dealing with the action of light and other atmospheric influences on the physical and chemical properties of wool

in its various forms. On exposure to light, more especially ultra-violet light, wool suffers progressive breakdown characterized by a decrease in strength and extensibility, an increased swelling-power with acids and alkalies, and increased solubility. These changes are associated with loss of sulphur, changed reaction of the wool with chemical coloring matters (dyes), and increased reducing-power. In the present section an exhaustive review of the literature on the subject is made and an interpretation given in terms of modern conceptions of animal fibre reactivity. (C)

X-ray Diffraction Study of the Swelling Action of Several Quaternary Ammonium Hydroxides on Cellulose Fibres. Wayne A. Sisson and William R. Saner. *J. Phys. Chem.*, June 1939, P. 687–99.

When cellulose fibres, either native or mercerized, are treated with a quaternary ammonium hydroxide, they increase in diameter and give a new X-ray diagram which differs from that of the original cellulose. These results are best explained by assuming the fibre to have a dual structure; the increase in fibre diameter is due to an intercrystalline material which swells indefinitely with the reagent, while the change in X-ray diagram is due to the formation of a swelling compound between the reagent and the crystalline cellulose. (C)

II. Yarns and Fabrics

Nylon. More Information About This Intensely Interesting New Fibre. *Silk J. & Rayon Wld.*, 1938, Nov., P. 18–21; Dec., P. 25, 28; 1939, Feb., P. 30; Mar., P. 20. (C)

Oil Emulsions: Preparation and Use in Spinning. *Klepzig's Textil-Z.*, 1938, V. 41, P. 688–90, 702–4, 712–3; abs. in *J. T. I.*, June, 1939, P. A377.

The use of oil emulsions in the spinning of textile fibres, especially wool and staple fibre, is discussed, and the preparation of suitable emulsions is described. Various emulsifying agents for use in the preparation of oil emulsions are mentioned and the properties and advantages of the self-emulsifying spinning oil, Servital OL, are briefly discussed. (C)

Oils for the Knitting Industry. *Wool Record*, 1939, V. 55, P. 604–5, 611; abs. in *J. T. I.*, June 1939, P. A388.

The requirements of a "knitting finish" on yarn are that it should confer pliability, have a lubricating action, reduce fluffiness and be readily removed in scouring. For wool hosiery yarns, the usual high-grade knitting oils consist mainly of olive or neatsfoot oils, or of ester oil, the most satisfactory types being "self-emulsifying." Alkali should not be added to oils for knitting, since it tends to injure the wool and makes certain colors bleed. The pH of the oil should not exceed 8–8.5. Artificial silk and silk knitting oils are also discussed. (C)

Peralta Thread and Burr Crusher. *Text. Mfr.*, July 1939, P. 306.

A new device for the removal of hard threads and burrs from woolen blends. (C)

POLYMERIZATION. E. K. Rideal. *Text. Mfr.*, June 1939, P. 246–7.

Abstract of the Mather Lecture at the recent annual conference of The Textile Institute at Bath, Eng. Polymerization and its bearing on the production of new synthetic fibres and finishes for textile fibres are treated by an authority. (C)

NON-SLIP FINISHING OF WOVEN AND KNITTED FABRICS. "Technologist." *Text. Merc.*, 1938, V. 99, P. 322; abs. in *J. T. I.*, Nov. 1938, P. A674.

The liability of draw rollers on finishing machines to displace warp or weft threads, especially in rayon fabrics, is obviated by placing strips of fabric near the ends of the rollers. Fabric impregnated with a very dilute solution of rosin soap and then dried is extraordinarily resistant to slippage. By rinsing the fabric in cold water before drying, cohesion is secured without stiffness. Water-soluble rosins of the synthetic type are also available. E. P. 486,306 describes a method for making rosin water-soluble. (C)

SHRINKAGE OF COTTON GOODS BY WASHING: FUNDAMENTAL PRINCIPLES THAT GOVERN THE. G. E. Collins. *J. T. I.*, March 1939, P. P46–P61. (C)

SPINNING ROOM HUMIDITY. H. L. Kempaner. *Text. Wld.*, Feb. 1939, P. 52–3.

The theory that coarse yarns require a higher percentage of moisture than fine has been a subject of debate in the air-conditioning and cotton-manufacturing fields for some time. However, after considerable research in which innumerable tests with various types of yarns have proved that the spinning of coarse yarn is more efficient at higher humidity, this theory is rapidly becoming recognized. (C)

TEXTILE INSPECTION WITH ULTRA-VIOLET LIGHT. J. F. Springer. *Rayon Tex. Mo.*, 1939, Jan., P. 73–4; Feb., P. 74–5. (C)

SULPHONATED MINERAL OILS FOR THE WORSTED INDUSTRY. *Bull. Lab. Anal. Rech. Ind., Roubaix*, 1938, No. 40, P. 11–18; abs. in *J. T. I.*, Feb. 1939, P. A94.

Tests have been made on three samples of sulphonated mineral oil and a sample of olive oil. The sulphonated oils were more easily removed by water than was olive oil, but not more easily removed by soap. It is therefore concluded that they have no practical advantage over olive oil as regards ease of removal. Two of the oils had a less yellowing effect than olive oil, but one of these showed a darker coloration. When oiled tops were dyed with acid colors in the same bath, those oiled with sulphonated oils had a greater affinity for dyestuff than those oiled with olive oil, but the residual oil tended to promote rubbing of the dyestuff. The sulphonated oils had an anti-oxidant action on olive oil. Although easily emulsifiable alone, they did not emulsify vegetable oils. Attention is drawn to Kehren's paper on the use of olein and mineral oil for wool oiling (see *J. T. I.*, 1938, P. A268). (C)

TERRY TOWELLING: WEAVING. G. Bonnet. *Fils et Tissus*, 1938, V. 26, P. 543, 545; abs. in *J. T. I.*, Dec. 1938, P. A737.

A weave for terry towelling is shown which is in effect a development of a plain weave. Pile warps are caused to form loops at every third pick

and each pile warp loops alternately on the two sides of the fabric. The pile threads are held more firmly in this weave than in the usual terry weave and pulling of a loop in the fabric produces a slight effect on both sides which, however, is hidden by neighboring loops, instead of an obvious fault on one side only. (C)

THREADS: THEORY OF TWISTING. V. T. Kostitsin. *Bull. Acad. Sci. U. S. S. R.*, 1938, No. 2, P. 105–19 (Russian); (through *Zbl. Mech.*, 1938, V. 7, P. 342); abs. in *J. T. I.*, Feb. 1939, P. A96.

The distribution of tension in threads on twisting, with and without additional tension, is calculated on the assumption of Hooke's law and neglecting the effects of friction between the fibres. (C)

TWILLS: DIFFERENCE BETWEEN TWO FACES. E. Gräbner. *Monatsh. Seide u. Kunstseide*, 1938, V. 43, P. 327–32; abs. in *J. T. I.*, Dec. 1938, P. A737.

By a study of examples it is shown why the two faces of ordinary twill fabrics have different appearances and how, by the use of combinations of two twill lines, it is possible to produce twill fabrics that have the same appearance on both sides. The influence of the directions of warp and weft twists on the clearness of twill effects is also studied. (C)

TWISTING: CONTRACTION IN. J. A. Colin. *L'Ind. Text.*, 1938, V. 55, P. 375–78; abs. in *J. T. I.*, Nov. 1938, P. A658.

Changes in length and count produced by twisting together two or more ends of yarn with twists in the same and in the opposite direction to the twist of the single yarn are examined and curves are given showing percentage contraction against twist and against twist coefficient for cotton yarns of various counts with 2 to 5 ends and twisted under constant tension. The possibility of deducing a general equation for these curves is discussed and it is pointed out that such an equation could not be applied in ordinary mill practice as the tension in twisting is an important factor, varies constantly on the twisting frame, and cannot be measured on the machine. (C)

VISTRALAN, A NEW FIBRE FOR THE WOOL INDUSTRY. *Mell. Textilber.*, 1939, No. 3, P. 198.

It is generally necessary to apply special dyeing processes or to use the two-bath process for dyeing viscose staple fibre mixed with wool. The I. G. Farbenindustrie A.-G. has developed a new fibre, known as Vistralan, that can be dyed exactly like wool and the other properties of which, including especially its superficial structure, also closely resemble those of wool. The article shows a number of original samples of pure Vistralan yarns and fabrics and mixture fabrics with wool, demonstrating how the new fibre can be used in the wool trade. (C)

WARP BREAKAGES. Stephen Major. *Text. Recorder*, Feb. 6, 1939, P. 24, 26, 30.

How to determine the causes of these defects, and some practical hints on their prevention. (C)

WARPS: SIZING AND LUBRICATING. G. R. Kaulen. *Chloptschatobumashnaja Prom.*, 1937, V. 7, No. 10, P. 29–31 (through *Chem. Zentr.*, 1938, ii, P. 1880); abs. in *J. T. I.*, Feb. 1939, P. A99.

It is claimed that the best procedure in sizing cotton warps is to apply wax or a paraffin-stearin emulsion to the yarn. Tests with paraffin-stearin, stearin-olein, and stearin-olein-castor oil emulsions show that paraffin may be dispensed with. (C)

WOOL FABRIC: THERMOSTATIC ACTION. A. B. D. Cassie, B. E. Atkins and G. King. *Nature*, 1939, V. 143, P. 163; abs. in *J. T. I.*, March 1939, P. A190.

Attention is called to the effect of the rapid absorption of moisture by textiles and the consequent development of heat in counteracting heat loss on exposure to a cold atmosphere. Thus, a kilogram of wool fabric when taken from an atmosphere at 18° C. and 45% R.H. to one at 5° C. and 95% R.H., loses 4000 calories because of the specific heat effect but changes in regain from 10 to 27%, and the heat involved is such that it would really have to lose 100,000 calories before reaching the lower temperature. (C)

WOOL FELTING: THEORY OF. Justin-Mueller. *Rev. gén. mat. col.*, 1938, V. 42, P. 378–81 (through *Brit. Chem. Abs. B.*, 1938, V. 57, P. 1395); abs. in *J. T. I.*, Feb. 1939, P. A105.

The author's theory, first suggested in 1904 (*Bull. Rouen*, P. 35), that wool felting is due to the production of a quasigelatinous surface by which fibres become mechanically stuck together, has been confirmed by experiment. The biuret test shows that a semi- or pseudo-hydrolysis takes place, the intermediate stage produced being a kind of protogel. Complete hydrolysis does not occur, as no S compounds are detected in extracts of fulled materials. Pretreatment with baths containing sulphuric acid, or acid mercury salts, produces a start of the pseudohydrolysis, which accelerates subsequent fulling. Tests with lead acetate or nitroprusside are indicated for the control of fulling. (C)

III. CHEMICAL AND OTHER PROCESSING (NOT OTHERWISE CLASSIFIED)

DYE EXHAUSTION CURVES: APPLICATION. F. Schütz. *Bull. Fed. Int. Assoc. Chim. Text. et Couleur*, 1938, V. 3, P. 5–34.

The author demonstrates, by reference to the Chlorantine Fast dyes, the practical applications of curves obtained by plotting the percentage of dye absorbed by the fibre against conditions of dyeing, such as time, temperature, and additions to the liquor. The curves described are those for nominally 1% dyeings. The various features exhibited by the curves are discussed such as differences in the rate and completeness of the exhaustion of the bath. It is then shown that by plotting such curves together in pairs or threes, some idea may be obtained of the outcome of dyeing cotton with mixtures, such as how the shade might change with time and temperature as dyeing proceeds, or how the shade might vary along the length of a piece in dyeing with the padding machine. (C)

DYED COTTON: TENDERING BY LIGHT. S. Schmidt Nielsen. *Papir J.*, 1938, V. 26, P. 111–12, 127 (through *Papier Fabr.*, 1938, V. 36, *Auszüge*, P. 173); abs. in *J. T. I.*, March 1939, P. A189

An account is given of work by O. H. Waardahl on the influence of dyes on the tendering of cotton by light, effects being measured by copper numbers. Eosin-dyed material suffers a three-fold rise of copper number on exposure before an Osram-Nitra lamp, but Sirius light scarlet B has no effect. Indanthrene yellow G. K. and gold-orange G. have a protective effect under the quartz lamp. The latter dye is reduced, suggesting that the protection is an oxidation-reduction process. (C)

DYEING RECOVERED WOOL CONTAINING CELLULOSE ACETATE STAPLE FIBRE. *Mell. Textilber.*, 1938, V. 19, P. 722–24.

Difficulties experienced in the dyeing of woolen rags and recovered wool containing cellulose acetate staple fibre by the usual single and two-bath processes are discussed and two methods found to give satisfactory results are described. (C)

ETHANOLAMINES: USE IN THE TEXTILE INDUSTRY. F. Ohl. *Monatsh. Seide u. Kunstseide*, 1938, V. 43, P. 498–502; abs. in *J. T. I.*, March 1939, P. A172.

The use of ethanolamines and their derivatives in the preparation of emulsions of fats, oils, waxes, resins, hydrocarbons, etc., for use in scouring, bleaching, finishing, sizing, waterproofing, washing, wetting, softening, lubricating and similar preparations, and also in the treatment of rayons for softening, delustering, and reducing static electricity, and in dyeing, printing and other processes is discussed. Patent literature relating to the various uses is reviewed. (C)

FOAM-PREVENTING AGENTS. F. Ohl. *Monatsh. Seide u. Kunstseide*, 1938, V. 43, P. 411–13; abs. in *J. T. I.*, Jan. 1939, P. A38.

A general discussion of foam formation, especially in sizing and finishing preparations, the action of foam-preventing agents, the various foam-preventing agents now available and their uses. (C)

GLUE WASH: APPLICATION IN DYEING AND FINISHING. B. Faden. *Leipz. Monats. Text. Ind.*, 1938, V. 53, P. 313; abs. in *J. T. I.*, March 1939, P. A171.

Very good results are obtained by the use of a bone glue bath in place of the usual fuller's earth bath to improve the fastness to rubbing of dyed wool and half-wool goods, especially dark shades. Details of the procedure are discussed and examples of the treatment of goods dyed with indigo, alizarine, logwood and other dyes are described. (C)

HIGH POLYMERIC CHEMISTRY: ASPECTS OF. H. Mark. *Nature*, Nov. 26, 1938; reprinted by *J. T. I.*, Feb. 1939, P. P39–P43. (C)

INDIGO VATS: ELECTROMETRIC TITRATION. N. Strafford and W. V. Stubbings. *J. Soc. Chem. Ind.*, 1938, V. 57, P. 242–45.

A method for the determination of sodium hydrosulphite and free indigo in reduced indigo preparations depends on the preferential electro-

metric titration of sodium hydrosulphite by Fehling's solution in an atmosphere of nitrogen. Details of the apparatus, manipulation and calculation are given. An extension of the method permits the determination of free indigo in leucoindigo solutions, a definite amount of sodium hydrosulphite being added to the system. (C)

LINSEED OIL: ACTION ON RAYON. J. Rolland. *17me Congrès Chim. Ind.*, 1937, P. 113–20; abs. in *J. T. I.*, Jan. 1939, P. A33.

The cause of streaky dyeing that is sometimes encountered in fabrics containing rayon warps sized with linseed oil is ascribed to the influence of peroxide formation during the drying of the oil. The amount of peroxide formed is determined by reduction with standardized stannous chloride in an atmosphere of carbon dioxide and iodimetric titration of the excess. The presumed formation of oxycellulose on the rayon is tested by staining with Rhodamine B extra and with silver nitrate, after de-sizing. A connection between the "active oxygen" content of an oil and the extent of oxycellulose formation is established in a case of streaky rayon fabric. It was observed that the trouble is increased if the warp is exposed to sunlight and that more oxycellulose is formed if the "drying" of the oil takes place in a moist atmosphere instead of a dry one. Attempts to prepare a boiled oil free from risk were without definite result. No particular success was obtained by adding a reducing substance to the oil, but level dyeings, with acetate warps, were secured by steeping the cloth, before desizing, in a 20–50% solution of 40% formalin. (C)

LINSEED OIL SIZED RAYON YARNS: DYEING. G. Taron. *L'Ind. Text.*, 1938, V. 55, P. 496–97; abs. in *J. T. I.*, Jan. 1939, P. A34.

Injury of the fibre by linseed oil sizes may be prevented by adding reducing agents such as aldehydes to the size or by treating the material after sizing with a solution of an aldehyde, *e.g.*, formaldehyde. (C)

MARINE ALGAE: UTILIZATION IN JAPAN. *J. Soc. Chem. Ind. Japan*, 1938, V. 41, P. 169B–170B; abs. in *J. T. I.*, Nov. 1938, P. A673.

Figures are given of the annual production of marine algae and their products in Japan for the years 1932 to 1936. The percentages of the important constituents, namely mannitol, alginic acid, iodine and K chloride are also tabulated. A process for the isolation of mannitol and alginic acid is outlined. The output of the latter is expected to reach 200 tons this year. Alginic acid and its salts can be used for textile pastes, paper sizing and the waterproofing of paper and cloth. Treatment of textile fibres and threads with 0.1% solution of sodium alginate markedly reduces their coefficient of friction and greatly increases their tensile strength. (C)

NILOX OIL PATENTS. *Wool Record & Text. Wld.*, April 6, 1939, P. 771–72.

The three Nilox oil patents describe novel methods of refining oils for textile purposes, the object of which is to destroy easily oxidizable components of the oil, to remove oxidizing catalysts, and to add to the purified and oxidation-stable oil a safe anti-oxidant of a similar chemical nature to wool itself. It is claimed that the resultant oils are more stable to oxidation than olive oil, though as easy to scour out. They are said not to develop color, smell, rancidity or resinous substances on storage. It is also

evident that, as they are manufactured products, they can be prepared to a standard specification and delivered to an unvarying quality grade. In other publications it has also been stated that the raw materials for Nilox oils are independent of political disturbances outside the Empire, and that the price is far less liable to fluctuation than that of olive oil. (C)

PRINTING PASTE THICKENERS: TESTING. E. von Pezold. *Mell. Textilber.*, 1938, V. 19, P. 516–17, 593–94, 743–44.

Various thickeners, including tragacanth, Quellin, wheat starch, potato starch, Thickener X, and industrial gum, were tested according to the methods described in a previous paper, and observations were also made on the changes in properties with time of thickenings standing at different temperatures. The results are given in tables and graphs and discussed. Printing pastes were then prepared with the various thickeners and with mixtures of the thickeners, and prints were made on cotton and cotton-viscose rayon fabrics, using as dyes Indanthrene brown RRD, Alizarine yellow R, Indigosol green IB, Indathrene blue GCDN, Rapidogen violet B, aniline black, and the dye obtained from Naphthol AS base and Fast Red KB base. The best prints were obtained with the usual neutral starch-tragacanth thickening. (C)

IV. RESEARCH METHODS AND APPARATUS

BIREFRINGENCE OF FIBRES: SIMPLE METHOD OF DETERMINING. R. H. Marriott. *J. Soc. Leather Trades Chem.*, 1938, V. 22, P. 294; through *Analyst*, 1938, V. 63, P. 767; abs. in *J. Soc. Dyers Col.*, March 1939, P. 171.

By measuring the thickness of quartz necessary to equalize the paths of the ordinary and extraordinary rays, which enables the retardation of one ray relative to the other to be obtained, the double refraction of crystals and fibres can be determined. By the use of plates of mica, the difficulties of technique of the quartz wedge method are eliminated and the cost is much lower. If the mica plate is inserted between crossed nicols, then, on rotating the polarizer, increasing amounts of retardation between the two transmitted rays may be obtained, and, if the plate has a suitable thickness, a position of the polarizer will be found for which a doubly refracting fibre placed between the analyzer and mica plate appears black or a luminous background; the extent of rotation of the nicol necessary for this depends on, and is a measure of, the double refraction of the fibre. The optimum thickness of the mica plate is that which produces a difference of one-quarter of a wavelength of a light in the phase of the two emergent beams of light. The type of anisotropy shown by a fibre, *i.e.*, whether the elongation is positive or negative, may be determined, because, with a positive elongation, the ray vibrating in the direction of the long axis of the fibre is transmitted more slowly than the ray vibrating at right angles to it. (C)

BOBBINS: SAMPLING FOR STRENGTH TESTS. A Herding. *Mell. Textilber.*, 1938, V. 19, P. 736–38; abs. in *J. T. I.*, Dec. 1938, P. A763. (C)

COTTON FIBRE: STRENGTH UTILIZATION COEFFICIENT IN YARN. K. I. Koritzki. *Chloptschatobum. Prom.*, 1938, V. 8, No. 1, P. 20–5 (through *Chem. Zentr.*, 1938, ii, P. 981); abs. in *J. T. I.*, Dec. 1938, P. A764.

The per cent fibre-strength utilization coefficient of cotton when spun into yarn is given by $B = 0.22n + 0.26a - 4.2p + 23.0$, where n is the number of fibres in the cross-section of the yarn, a is the twist factor, and p is the strength of the fibre. In mixing cottons, not only should the staple lengths be considered, but their B coefficients should not differ by more than 3%. (C)

COLOR REACTION FOR DETECTION OF WOOL FIBRES TREATED WITH HYDROGEN PEROXIDE. J. Pinte. *Rev. Gén. Mat. Col.*, 1938, V. 42, P. 281–82 (through *Brit. Chem. Abs.*, 1938, V. 57, P. 1147); abs. in *J. T. I.*, Jan. 1939, P. A57.

The treated fibres are detected by treatment with aqueous potassium iodide in the presence of starch. Residual oxygen in the fibres may be determined by use of potassium iodide and manganese chloride and titrating the liberated iodine with aqueous sodium thiosulphate. Details of these tests, which are specific for hydrogen peroxide treated wool, are given. (C)

COPPER AND MANGANESE IN TEXTILES: DETERMINATION OF. Kehren. *Mell. Textilber.*, 1939, No. 3, P. 213.

The colorimetrical determination of the copper content of textiles by means of sodium diethyl-dithiocarbaminate yields reliable analytical results when certain other metals are absent. A direct colorimetrical comparison cannot be carried out when considerable quantities of iron or zinc are present in the residual ash of rubberized or unrubberized fabrics, owing to the disturbance caused by a yellowish natural coloration (iron) or a considerable turbidity of the solution (zinc). The electrolytic method of determination first described by Hiltner (l. c.) has proved satisfactory for the exact quantitative determination even of the very smallest quantities of copper in textiles and a description is given in the present article. The experience of the author goes to show that the manganese content plays only a subordinate part in determining whether a fabric can be rubberized, because the manganese present in the raw fibre is in by far the majority of cases reduced to a harmless minimum during the course of the various finishing processes. Examination of numerous samples of fabrics did not show a higher percentage of manganese than 0.0011% in any single case, while most samples contained even considerably less. Any increase in the manganese content of rubberized fabrics is due to the unavoidable presence of manganese in certain filling agents. (C)

FINISHING AGENTS: STIFFENING AND SMOOTHING EFFECTS; MEASUREMENT. A. Prior. *Mell. Textilber.*, 1938, V. 19, P. 668–71.

The difficulty of expressing the stiffness, smoothness and other properties of finished fabrics by numbers is discussed and various methods of measuring these properties are mentioned. (C)

FIBRE MIXTURES: SPINNING QUALITY. E. Viviana. *Bollettino Cotoniera*, 1938, V. 33, P. 417–27; abs. in *J. T. I.*, March 1939, P. A187.

Typical load-extension diagrams are shown for cotton, wool, silk, rayon, stretch-spun rayon and hemp and examples are given in support of the

argument that the tensile behavior of a yarn spun from a mixture of two fibres can be explained from the diagrams, successful blending requiring fibres of similar diagrams. (C)

"General Electric" Recording Spectrophotometer: Development and Application. (1) A. C. Hardy. (2) J. L. Michaelson. (3) K. S. Gibson and H. J. Keegan. *J. Opt. Soc. Am.*, 1938, V. 28, P. 360–64, 365–71, 372–85. (C)

Grease in Scoured Wools: A Rapid Method of Determining. Joseph W. Creely. *Am. Dye. Rptr.*, April 3, 1939.

A quick method using petroleum ether and shaking with wool for 15 minutes instead of extracting 20 times in a Soxhlet apparatus is recommended. Results when corrected from a curve differ from the Soxhlet extraction by a negligible amount. This method is the result of experimental work in the laboratory of Eavenson & Levering Co. (C)

Lanital: Determination in Mixture Fabrics. *Mell. Textilber.*, 1938, V. 19, P. 706.

Various methods for the qualitative and quantitative analysis of Lanital in mixture fabrics, especially wool-Lanital mixtures, are briefly described. (C)

Jute Yarn: Effect of Light, Oxygen and Heat on the Durability of. A. C. W. Bot and A. C. van Vreeswijk. *Mell. Textilber.*, 1939, No. 2, P. 115.

Abbreviated durability tests were carried out on various qualities of jute yarn in order to compare its loss of strength with that of hemp, flax, and cotton yarn. Jute lost strength to the same extent as the other yarns, or even less, as the result of the heating tests carried out in the dark, a fact that goes to prove that jute is as durable as flax, hemp, and cotton when kept in the dark. It behaves differently, however, when the tests are carried out in daylight. These tests, as well as tests carried out with the fugitometer and photo-oxidation tests revealed that jute was much more severely tendered than the other yarns. The effect of light on jute is due to oxidation of lignin, as could be demonstrated by the oxygen absorption test. Jute fibres show maximum lignification and also absorb oxygen to the greatest extent, being followed by hemp, flax, and cotton, in that order. Batching oil protects the fibre during the heating tests, but yarn that has been batched loses strength to a greater extent during the light tests than yarn from which the batching oil has been extracted with ether. (C)

Microscopes: Review of Mechanical Improvements in—in the Last Fourteen Years. R. S. Clay. *J. Roy. Microscop. Soc.*, March 1938, V. 58, P. 1–29; abs. in *Eastman Kodak Abs. Bull.*, Dec. 1938, P. 588. (S)

Microscopic Fibre Investigations. G. Stühmer. *Deut. Textilwirt.*, 1938, V 5, No. 20, P. 26–8; No. 22, P. 22–4; abs. in *J. T. I.*, March 1939, P. A188.

Faults due to fibre damage in (1) cotton, staple fibre and cotton-staple fibre fabrics and (2) wool carpet yarn are detected by microscopic examina-

tion in conjunction with simple chemical methods. Photomicrographs are given. In the wool carpet yarn, alkali damage is detected by Allwörden's reaction and acid damage by the Krais-Markert-Viertel reaction. (C)

PHOTO-ELECTRIC SEED COTTON STAPLING DEVICE. B. Johnson. *J. Agric. Res.*, 1938, V. 57, P. 41–56; abs. in *J. T. I.*, Nov. 1938, P. A692. (C)

ROUND AND FLAT WEAR TESTERS: COMPARISON. A. Heider. *Klepzig's Textil-Z.*, 1938, V. 41, P. 618–23; abs. in *J. T. I.*, Feb. 1939, P. A125. (C)

SHEET CELLULOSE: APPLICATION IN POLARIZING MICROSCOPE. H. H. Pfeiffer. *Kolloid Z.*, 1938, V. 85, P. 49–52; abs. in *J. T. I.*, Feb. 1939, P. A132.

Investigations on cytoplasm are reported in which the nicols used in the polarizing microscope were replaced by pieces of sheet cellulose set up in the form of a Bravais double plate fitted into the cross-thread ocular. (C)

SILK INDUSTRY: WORK OF A RESEARCH DEPARTMENT IN THE. F. H. Clayton. *J. T. I.*, March 1939, P. P62–P68.

Gives a brief general idea of some of the work done in the testing department of a large silk firm. (C)

SILK: WATER OF CONSTITUTION AND HYDRATION. A. Baroni. *Boll. Uffic. R. Staz. Sperim. Seta*, 1938, V. 8, P. 25–7; abs. in *J. T. I.*, Jan. 1939, P. A56.

Cotton dried at 110° C., and wool and silk dried at 140° C., were brought to various regains at 25° C. by storage over sulphuric acid solutions and the specimens were then placed in water in a Dewar vessel and the temperature rise measured by a Beckmann thermometer. Curves connecting heat of hydration with moisture content are reproduced. The curve for cotton is smooth and lies between that for wool (higher) and silk (lower), these displaying a break at 1.5% moisture content for silk and at 2% for wool. The bearing of this on the difference in structure between cellulosic and protein fibres is discussed. (C)

SINGLE-STRAND TESTING. Anon. *Text. Wld.*, Feb. 15, 1939, P. 48–9.

Its use for control of product and processes in dyeing and converting rayon yarns. (C)

STAPLE FIBRE: TWO NEW METHODS OF DISTINGUISHING BETWEEN—OF THE LANUSA TYPE AND THE CUPRAMMONIUM TYPE. Recognition of Hydrophobe Staple Fibre. P. A. Koch. *Mell. Textilber.*, 1939, No. 3, P. 177.

Lanusa is based on viscose and is made by the stretch-spinning process with a flow of liquid applied for the production of cuprammonium rayon. The author has developed and elaborated a dark-field illumination process by means of which staple fibre prepared by the Lanusa process can be distinguished from that produced from ammoniacal copper oxide. The article contains instructions for the use of the microscope for the purpose. It is further pointed out that the Schwarza W staple fibre is often strongly lubri-

cated, which makes itself evident in the dark field as a marked superficial structure. The characteristic difference is that Lanusa and Schwarza W show a brilliant streaky structure in the interior, which is not to be seen in staple fibre made from ammoniacal copper oxide. The author suggests making use of swelling in ammoniacal copper oxide as a means of distinguishing between hydrophile and hydrophobe staple fibre. That is to say, normal viscose staple fibre swells uniformly, while hydrophobe staple fibre breaks up into pieces. (C)

SYNTHETIC PLASTICS: COLD TESTING. *Kunststoffe*, 1938, V. 28, P. 171–72; abs. in *J. T. I.*, Dec. 1938, P. A769.

A piece of apparatus is described, with diagrams, for testing the strength of thermoplastic materials at low temperatures and also their bending and cracking qualities. Artificial leather, waxed cloth, etc., can be tested. (C)

TESTING TEXTILES: PROGRESS REVIEW OF. Charles J. Huber. *Rayon Tex. Mo.*, Feb. 1939, P. 69–70, 73.

A brief review of new testing methods, and a bibliography of recent literature in which they are described in detail. (C)

THREAD TENSILE TESTING INSTRUMENT. E. Viviani. *Bollettino Cotoniera*, 1938, V. 33, P. 517–27; abs. in *J. T. I.*, March 1939, P. A188.

A device for recording breaking loads and preparing load-extension diagrams on a rotating drum is described in which the load is indicated by the changes in resistance in a pile of specially prepared discs of charcoal. This pile is compressed through a lever system and forms one arm of a Wheatstone bridge. The deflections of a mirror galvanometer are transferred to the drum by an optical system, and the drum is moved by a rigid thread that carries the upper grip. (C)

WATERPROOFED FABRICS: TESTING. P. Laforest. *TIBA*, 1938, V. 16, P. 615–21; abs. in *J. T. I.*, Feb. 1939, P. A127.

Various methods of testing waterproofed fabrics are critically discussed. Suitable methods are classified into soaking methods, pressure methods, and sprinking methods and are briefly described. (C)

X-RAY STUDIES OF TEXTILE FIBRES. G. Champetier. *Tech. moderne*, 1937, V. 29, P. 809–15 (through *C. A.*, 1938, V. 32, Col. 5633); abs. in *J. T. I.*, Nov. 1938, P. A694.

Methods have been developed to distinguish between, and to detect admixtures of fibres of cotton, wool, mercerized material and various substituted products. (C)

YARN TENSION IN SPINNING FRAMES: DEVICE FOR INDICATING—AND FOR CONTROLLING THE SPEED OF THE MACHINES. *Mell. Textilber., Eng. Ed.*, 1938, V. 19, P. 114; abs. in *J. T. I.*, Jan. 1939, P. A18.

A beam of light runs parallel to the length of the frame, and casts a shadow picture of the path of the threads bent in dependence of the thread

tension, on a photocell which in turn controls the speed of the motor driving the frame. (C)

YARN TESTING: SHOULD LENGTHS OF YARN BE TESTED ON THE RUNNING THREAD? Oertel. *Mell. Textilber.*, 1939, No. 2, P. 110.

The objection is raised to the ordinary method of testing tensile strength that the part of the yarn length tested is too short and that the test takes place in a load range that lies outside the further treatment of the yarn. Tests carried out on the running yarn, on the contrary, show the properties in the actual range of manufacture limited by those values of load and elongation at which thread breakage does not appear. By means of an example with the use of a suitable scale of that kind for the evaluation of the properties for further treatment the author shows the way in which tests carried out on the running yarn were able to bring out differences in the properties of two yarns more clearly and place them in a more correct light than the tensile strength test could do. (C)

V. PURE SCIENCE, ECONOMICS AND MISC.

ADSORPTION OF ALKALI BY WOOL. J. Powney and C. C. Addison. *Trans. Faraday Soc.*, 1938, V. 34, P. 1439–45; abs. in *J. T. I.*, Feb. 1939, P. A141.

The adsorption and desorption of caustic soda by purified merino and Lincoln wools has been investigated by means of a conductivity method over a range of temperatures. Some data for the adsorption of alkali on mohair are also included. The results confirm the observation of McMahon and Speakman that root wool which has been unexposed to light adsorbs little alkali below pH 10. Samples of fine merino wool having high surface area showed appreciably greater adsorption of caustic soda than did the coarser Lincoln wool. The differences, however, are not as great as would have been anticipated had the adsorption been purely a surface effect. Desorption of alkali from wool follows the same principles as adsorption, except under conditions of very low alkali content when anomalous effects are observed. (C)

ALLERGIC REACTIONS: PROBLEMS IN THE SELECTION OF TEXTILES AND RELATED SUBSTANCES IN CASES OF. L. Stedman and M. Ford. *J. Home Econ.*, 1938, V. 30, P. 161–69 (through *Exper. Sta. Rec.*, 1938, V. 79, P. 718); abs. in *J. T. I.*, Feb. 1939, P. A144.

From a survey of the medical literature with respect to textiles and related substances, such as feathers, furs, leather, rubber, household dust, and household objects, as sources of allergic disturbances, the authors conclude that allergic reaction to these substances is a relatively common manifestation and that the best method of treatment is the elimination of the offending substances. One advantage of accurate labeling for household and garment textiles is to enable the allergic individual to avoid the purchase of materials containing these substances. The bibliography lists 21 references.

AMYLASE: RATE OF ACTION ON STARCHES. Vera D. Martin and J. M. Newton. *Cereal Chem.*, 1938, V. 15, P. 456–62; abs. in *J. T. I.*, Nov. 1938, P. A702.

The rate of hydrolysis of starch substrates by soybean amylase was measured by a potentiometric determination of the reducing sugars formed. The starches used were corn, potato, rice, wheat and tapioca and substrates were made from them by heating at 60°, 70° 80°, 90°, 100° and 120°. All substrates contained 2% of starch and were at pH 5 as measured by the glass electrode. It was found that the temperature at which the starch substrate is prepared has a definite effect on the rate of the digestion and that the optimum temperature depends on the kind of starch, being 70° for potato 80° for tapioca, 90° for wheat and corn starches, and 80° or above for rice starch. A possible explanation of the retarding effect of heating above these optimum temperatures is given. These results suggest that there is some effect on the starches when heated, other than the swelling and rupture of the granules. It is possible that heating causes agglutination of the particles in the paste, so that individual starch molecules would be less accessible and the digestion retarded though eventually reaching the same degree of hydrolysis. (C)

AVENA COLEOPTILE: OBSERVATIONS ON MEMBRANES OF EPIDERMAL CELLS OF. Wanda K. Farr and Wayne A. Sisson. *Contrib. Boyce Thompson Inst.*, 1939, V. 10, No. 2, P. 127–37. (C)

CELLULOSE: ACTION OF DILUTE NITRIC ACID. I. Schimoda and T. Daimon. *J. Cellulose Inst., Tokyo*, 1938, V. 14, P. 43–7; abs. in *J. T. I.*, Nov. 1938, P. A703.

The conclusion is drawn that the effect of the acid is merely one of hydrolysis. (C)

CELLULOSE: DEGREE OF POLYMERIZATION OF—IN OLD FABRICS. H. Staudinger and F. Reinecke. *Mell. Textilber.*, 1939, No. 2, P. 109.

Artificial fibres always contain a polymolecular mixture of celluloses, so that the strength properties of synthetic yarns of the same average degree of polymerization differ according to the composition of the mixture of polymeric homologous celluloses. Cellulose molecules may form crystallites of varying size. Molecules and crystallites are oriented differently in synthetic yarns according to the spinning process used. In order to test the influence of the average degree of polymerization on the strength of the fibre, it is necessary to examine those fibres in which the cellulose molecules of various length are arranged as similarly as possible. Fibres of that kind were produced by the decomposition of cotton or ramie in the solid state by the action of acids or oxidizing agents. It was found that the strength properties of the fibres undergo little change when the average degree of polymerization falls from 3000 to about 600 or 700, but that the strength decreases very rapidly upon further decomposition. The decomposition of cellulose in dry air by oxygen can be followed by determining the degree of polymerization of the celluloses in old fabrics and a number of measurements of that nature were carried out on mummy wrappers and the like. It was thereby found that no cellulose showed a lower degree of polymerization than 200, even after lying for thousands of years. (C)

CELLULOSE, STARCH AND GELATIN SOLUTIONS: EFFECT OF ULTRA-VIOLET RADIATION ON VISCOSITY. J. Löbering. *Z. Elektrochemie*, 1938, V. 44, P. 743–47; abs. in *J. T. I.*, Jan. 1939, P. A74.

A report of a lecture on the kinetics of polymerization and the viscosity of high-polymerides. Mention is made of a quartz viscometer in which the effect of ultra-violet radiation on viscosities could be studied; the driving pressure could be increased to 3 atm. and the liquid apparently directed to different capillaries. It is reported that an effect of radiation was not observed with liquids of normal behavior. Similarly, solutions of starch in water, or paraffin in carbon tetrachloride, in which the pressure/flow relation is abnormal, were not affected by radiation. Other anomalous solutions, however, namely cellulose in phosphoric acid or sulphuric acid, cellulose acetate in acetone or methylene chloride, and gelatin or agar in water, suffered a decrease of viscosity on irradiation and the viscosity anomaly tended to disappear in time. (C)

CHEMOFLUORESCENCE. J. Plotnikow and J. Kubal. *Phot. Korr.*, June 1938, V. 74, P. 97–102; abs in *Eastman Kodak Abs. Bull.*, Jan. 1939, P. 45.

A quantitative study is given of the changes in the spectral distribution of the light emitted in the oxidation of luminol by hydrogen peroxide, by the addition of fluorescein, rhodamine, or esculin. This phenomenon is called "chemofluorescence." The influence of potassium ferricyanide when added in addition to the fluorescing substance has also been studied. The glow in all these reactions is intense and characteristic. (J)

COTTON: ADSORPTION OF WATER. R. E. and O. W. Neumann. *Kolloidny Shurnal*, 1938, V. 4, No. 1, P. 3–11, 13–18 (through *Chem. Zentr.*, 1938, ii, P. 1551); abs. in *J. T. I.*, Dec. 1938, P. A762.

(1) The adsorption of water by cotton from dilute alcohol (0.024–0.320 mol.) has been measured over the range 0–53° C. The adsorption potential was calculated, on the assumption that the water vapor pressure of the solution is the same as that of the absorbed layer. The characteristic function $\epsilon = f(X)$, where X is the bound water, is found to be independent of temperature, in accordance with Polanyi's theory. (2) Similar measurements were made with solutions of isobutyl alcohol, glucose and sucrose. The function ϵ is not the same for all solutions but is independent of temperature. (C)

COTTON SPINNING MACHINE: TWO HUNDRED YEARS OF THE. Ernest Braschler. *Interntl. Cotton Bulletin*, Oct. 1938, P. 91.

An historical sketch that is accurate in large part, although it fails to credit John Thorp as the inventor of the spinning ring. (C)

DERMATITIS: CHEMICAL CAUSES. W. Garner. *Industrial Chemist*, 1938, V. 14, P. 264–67; abs. in *J. T. I.*, Nov. 1938, P. A715.

A review of possible chemical sources of dermatitis, with special reference to textiles. Faults in manufacture, such as failure to remove irritant chemicals, are distinguished from cases in which the idiosynerasy of the wearer is plainly the main factor. The legal position of the dyer, as demonstrated by decisions cited, is held to be unfair. A bibliography is provided. (C)

DISSOLUTION OF CHEMICALLY MODIFIED COTTON CELLULOSE IN ALKALINE SOLUTIONS. L. J. Jolley. Part IV. Solvent Action of Cuprammonium Solutions. Part V. Solvent Action of Solutions of Cupric Hydroxide in Aqueous Ethylenediamine. *J. T. I.*, Jan. 1939, P. T4–T41.

The earlier papers of this series have dealt with the dissolution of chemically modified cotton cellulose in solutions of the alkali (Li, Na, K) hydroxides and of tetramethylammonium hydroxide. The solvent action of these solutions is in general restricted to a range of alkali concentrations in the region 2 to 4*N*, and at 15° C. attains its maximum with 3.3*N* lithium hydroxide, 3.0*N* sodium hydroxide and 2.5*N* tetramethylammonium hydroxide. Below these concentrations the solvent action falls rapidly, being in all cases negligible in 1*N* solutions.

Part IV shows that a general relation between the composition of cuprammonium solutions and their solvent action on cotton cellulose can be established only by assuming a partial conversion of the cellulose into a complex containing copper. The molar ratio of copper to cellulose in the complex can be estimated for the dissolved fraction of the cellulose by a graphical treatment of the solubility data, and for the undissolved fraction by measurements of preferential absorption of copper from the solution, when it was necessary to assume, however, that the absorption of water was relatively unimportant.

The object of the work described in Part V was to obtain further information on the nature of the complex, the existence of which has been deducted by Traube, Hess and others, and for which a number of different constitutions have been proposed. For this purpose, the system formed by cellulose and solutions of cupric hydroxide in aqueous ethylene-diamine (solutions of cupri-ethylenediamine) appeared to be a more favorable subject of study than the cellulose-cuprammonium system. The system formed by cellulose and cupriethylenediamine solutions offers the possibility of estimating the ratio of amine, as well as copper, to combined cellulose in the complex, by measurement of the concentration changes in solution, while the very great excess of ammonia, and the consequent relatively small changes in its concentration, preclude a similar estimation in the cuprammonium system. (C)

ELASTIC PROPERTIES OF HIGH MOLECULAR SOLID MATERIALS. H. Dostal. *Monatsh. für Chem.*, 1938, V. 71, No. 3, P. 144–52; abs. in *Eastman Kodak Abs. Bull.*, Jan. 1939, P. 44.

The mathematical theory is developed and two corrections are incorporated. One is concerned with the small effective viscosity of the system and the other with the spatial requirements of the molecules. (S)

FIBRES: MICELLAR STRUCTURE AND DEFORMATION PROCESSES. O. Kratky. *Kolloid Z.*, 1938, V. 84, P. 149–68; abs. in *J. T. I.*, Dec. 1938, P. A785.

The theory of a dynamic method of investigation of the micellar structure of cellulose is presented. The network is conceived as being formed of longitudinal chains of micelles held together by cross links of micelles. Two types are postulated, the ideal loose network and the ideal close network. On deformation the former reacts as if the chains were separate and not prevented from extension by connection with neighboring micelles. (C)

OSMOSIS: EVIDENCE FOR A NEW THEORY. E. Ernest and J. Koczkás. *Z. Physik,* 1938, V. 109, P. 625–41; abs. in *J. T. I.,* Nov. 1938, P. A711.

The authors show from theoretical and practical considerations that osmotic phenomena cannot be explained by the kinetics of the dissolved substances but rather by the difference in vapor pressure of the solvent on both sides of the membrane. Experiments are described which show that in an osmotic system with solutions of the same concentration but at different temperatures on the two sides of the membrane solvent passes from the warmer to the cooler side. (C)

PHOTOMETRIC DETERMINATION OF CYSTINE, CYSTEINE, ASCORBIC ACID, AND RELATED COMPOUNDS WITH PHOSPHOTUNGSTIC ACID. B. Kassell and E. Brand. *J. Biol. Chem.,* Sept. 1938, V. 125, P. 115–29; abs. in *Eastman Kodak Abs. Bull.,* Dec. 1938, P. 591.

A photometric method for the simultaneous determination of cystine, cysteine, and ascorbic acid by a modification of the Folin-Lugg method is described A micromodification is given for the determination of cystine and cysteine in 10 mg. to 20 mg. of protein. A list of results obtained by several methods is also given. (S)

PLANT FIBRES: ISOLATION BY MEANS OF POLYHYDRIC ALCOHOLS. H. Erbring and H. Geinitz. *Kolloid-Z.,* 1938, V. 84, P. 215–22; abs. in *J. T. I.,* Dec. 1938, P. A778.

A process is described for the extraction of fibre from straw, broom, reed, potato haulm, etc., by means of glycerin or glycol at a high temperature and if necessary under high pressure. An addition of a small quantity of organic acid, for example, 0.2% of formic or acetic acid, hastens the process, although the acid contained in the fibres is itself sufficient. Swelling occurs as the lignin is dissolved and the union between the cellulose and its incrusting material is loosened, so that the mass divides into separate fibres with very little mechanical treatment. Mixtures of glycol or glycerin with water in equal proportions are particularly mild in action. Determinations of yield and a few analytical data of the raw material obtained are reported. The yield and time of reaction are the same for the concentrated or diluted glycol or glycerin, but the viscosities of the cellulose solutions in cuprammonium are greater for the product from 50% glycol. (C)

PROTEINS: CYCLOL STRUCTURE. I. Langmuir and Dorothy Wrinch. *Nature,* 1939, V. 143, P. 49–52.

A review of evidence for the cyclol theory of the structure of globular proteins. A distinction is drawn between the "cyclol bond," the making and breaking of which is a case of prototrophic tautomerism requiring only the migration of an H atom from NH group of one polypeptide chain to the CO group of the same or another chain, $>NH + OC< \rightleftharpoons >N-(HO)C<$, and the "peptide link," the making and breaking of which requires the intervention of another molecule, such as water. (C)

PROTEINS: ELECTROPHORETIC MEASUREMENTS. A. Tisselius. *Kolloid Z.,* 1938, V. 85, P. 119–28; abs. in *J. T. I.,* March 1939, P. A207. (C)

PROBABILITY PAPER: NOTE ON THE USE OF. E. W. H. Selwyn. *Proc. Phys. Soc.*, Nov. 1, 1938, V. 50, P. 914–18; abs. in *Eastman Kodak Abs. Bull.*, Dec. 1938, P. 599.

The method of plotting observations on probability paper becomes clear when the curve on probability paper is regarded as an integral of the histogram. The observations are divided into intervals, which may often conveniently be the natural interval of measurement, and the total frequency of observations up to and including the nth interval is plotted against the upper end of the nth interval. It is shown that in drawing a straight line to fit the observations, less weight should be placed on deviations from the line towards its ends than in the middle regions. (S)

"REFA" TIME STUDY SYSTEM: APPLICATION IN THE TEXTILE INDUSTRY. C. Reichelt. *Klepzig's Textil-Z.*, 1938, V. 41, P. 470–74, 503–6, 513–15; abs. in *J. T. I.*, Dec. 1938, P. A796.

The author explains the application of the German Refa time study method in the textile industry, discusses details of the technique as applied in different departments, the evaluation of the data, and various modifications and simplifications, and criticizes the application of the Refa method to the textile industry. (C)

TEXTILE FIBRES: EFFECTS OF DRYING. H. Haas. *Kunstseide*, 1939, V. 21, P. 88–90; abs. in *J. T. I.*, June 1939, P. A408.

The structure of cellulose and the effects of drying at high temperatures are discussed, and curves are given showing the decreases in viscosity, breaking strength and extension, and the increases in β-cellulose content, and copper and iodine numbers of cotton with increasing drying temperature. Marked changes are observed at drying temperatures above 100° C., and there is a decrease in strength at temperatures of 120–140° C. Extension at break begins to fall with drying temperatures between 100 and 120° C. while a change in dyeing properties is noticed with drying temperatures above 80–100° C. The effects of temperature and time in the drying of wool are briefly discussed, and it is pointed out that the strength of wool after heating for 24 hours at 50° C. is as low as after heating for one hour at 85–90° C. Similar results are obtained with cotton. It is pointed out that staple fibre is more sensitive to drying conditions than cotton and drying for periods of 1–2 hours at temperatures over 100° C. appears to be unsuitable treatment for such fibres. Attempts to shorten the drying time by using high temperatures, or to permit the use of low temperatures by unduly prolonging the period of drying are not to be recommended. Temperature and time of drying should be carefully adjusted to give the best results. (C)

TEXTILE TECHNOLOGY: FRONTIERS OF MODERN. E. R. Schwarz. *Rayon Text. Mo.*, 1939, Mar., P. 56–7; April, P. 69–73.

Abstract of a paper presented at a recent meeting of American Association of Textile Technologists, in which the author predicts that textile technology's greatest strides are very apt now to be taken through the cooperation of the biologist, botanist, physicist, engineer and chemist working jointly. (C)

TRANSFORMATION OF HYDRATE CELLULOSE INTO NATURAL CELLULOSE. T. Kubo and K. Kanamaru. *Z. physik. Chem. A.*, Sept. 1938, P. 341–60; abs. in *Paper Trade J.*, July 27, 1939, P. 25.

When hydrate cellulose is heated in liquids or gases at higher temperatures, the parallelism of the crystals increases. When polar liquids are used, the hydrate cellulose is changed to natural cellulose. (C)

WOOL FIBRES: ACTION OF ACIDS ON. W. H. D. *Monats. f. Text. Ind.*, 1939, V. 54, P. 58; abs. in *J. T. I.*, April 1939, P. A290.

A description of the action on the wool fibre of sulphuric, hydrochloric, nitric, sulphurous, acetic, tartaric and tannic acids in various concentrations. A table is given showing the percentages of sulphuric acid absorbed by wool from different concentrations. (C)

WOOL AND HAIR: ACTION OF MERCURIC CHLORIDE ON. J. B. Speakman and C. E. Coke. *Trans. Faraday Soc.*, 1939, V. 35, P. 246–62. (C)

X-RAY STUDIES OF CELLULOSE AND OTHER CARBOHYDRATES. E. G. Cox. *J. Soc. Dyers Col.*, Feb. 1939, P. 89–90; *Chem. & Ind.*, 1938, V. 57, P. 1126–7.

Careful examination shows that, whereas in the case of simple aliphatic compounds, *e.g.*, oxalic acid and pentaerythritol, the details of the structures have been determined by well-established methods with an accuracy of a few hundredths of an Angstrom unit, the structure of cellulose, for which details are also given to a small fraction of one Å. by over-enthusiastic investigators, has actually been reached by extensive use of what is called by Pauling the "stochastic" method, involving ascertained data for simple compounds, together with many assumptions of varying degrees of plausibility. The author discusses the importance of examining these assumptions in the light of the fundamental principles of X-ray analysis, and of deciding how far they are justified and how they can best be replaced by ascertained fact. (C)

Book Reviews

CASEIN AND ITS INDUSTRIAL APPLICATIONS. E. Sutermeister and F. L. Brown. 2nd Edition 1939. American Chemical Society Monograph Series. Reinhold Publishing Corp., New York, N. Y. 433 pp., illustrated. Price $6.50. *Rayon Text. Mo.*, April 1939, P. 106.

This exceedingly well compiled and edited book covers the following topics: Casein in Milk and its Isolation; Organic Chemistry of C.; Physical Chemistry of C.; Manufacture of C.; Testing and Analysis; Storage; Casein Plastics; Casein Glues; Casein in Paper Making; Casein Paints; Casein in the Leather Industry; Alimentary and Medical Uses of C.; Miscellaneous Uses of Casein and Statistics. Prof. Louis A. Olney of Lowell Textile Institute contributes a chapter on casein for textile purposes. (C)

CORN IN INDUSTRY. 2nd Edition. Corn Industries Research Foundation, 270 Broadway, New York, N. Y. 60 pp., illustrated. *Rayon Text. Mo.*, May 1939, P. 106.

A handbook of information on the starches, syrups, sugars and other industrial products made from the corn kernel with some 54 pictures of

various processes in the manufacture of corn products. The use of corn syrups and corn starches in the textile industry are described in some detail. Excellent literature references are given. It can be obtained from the Corn Industries Research Foundation without charge. (C)

FIBRO IN THE COTTON INDUSTRY. Published by Courtaulds, Ltd., London, Eng. 71 pp. *Text. Mfr.*, April 1939, P. 153.

The book gives data on spinning and other information on processing, including general notes on dyeing and finishing, and the characteristics of the materials. The booklet is a companion one to Courtaulds' handbook, "Fibro in the Woolen and Worsted Industries." (C)

COTTON COMBING MANUAL. H. H. Willis, Wm. G. Blair and Vernette B. Moore. The Textile Foundation, Washington, D. C.; multilithed copies for sale by H. H. Willis, Clemson, S. C., price $1.

The last of a series of seven texts on cotton yarn manufacture, prepared under the auspices of the Textile Foundation. The books of the series, which have been printed at intervals from 1936 to 1939, are as follows: "Cotton Classing Manual," "Cotton Opening, Cleaning, and Picking," "Cotton Carding," "Cotton Combing Manual," "Drawing Frames," "Roving Frames," and "Cotton Spinning." (C)

GENETICS OF COTTON. Dr. Sydney Cross Harland. Jonathan Cape, Ltd., 30 Bedford Square, London. Price 10s. 6d. net. *Interntl. Cotton Bulletin*, April 1939, P. 408.

Dr. Harland is one of the foremost plant geneticists in the world. This book presents in summarized form a working account of the development of genetics and the cytology of cotton to the end of 1936, and will be found of particular interest to botanists and breeders of cotton. (C)

OILSILK—ITS MANUFACTURE AND USES. Francis Warner. Harlequin Press Co., Ltd., Old Colony House, South King St., Manchester, Eng. 84 pp. Price 4s. 6d. *Text. Recdr.*, May 6, 1939, P. 53.

This is the only book dealing with the manufacture, history and making-up of oilsilk which, although it has been known for many years, has attracted comparatively little attention until recently. (C)

MICROSCOPIC METHODS FOR IDENTIFYING COMMERCIAL FIBRES. Circular C423, National Bureau of Standards. Copies obtainable from Superintendent of Documents, Government Printing Office, Washington, D. C., 10c. each.

A compilation of about fifty methods for testing textile fibres and paper making materials by microscopic means. Includes means of identifying the following fibres: Cotton, mercerized cotton, flax, wool, casein fibre, silk, "wild" silk, the different rayons, ramie, sisal, jute, coconut and abaca. Methods are also given for detecting used cotton and damaged wool. (C)

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